

Remarks

Claims 1-4, 7, 10-17, 21, 22, and 23 are pending. Favorable reconsideration is respectfully requested. Enclosed is the Declaration of Dr. Andreas Bacher for the Examiner's consideration. Please note that the independent claims directed to the silane-containing polyvinyl alcohol have been amended to recite a content of silane-containing monomer of 0.01 to 1 mol percent, support for which is contained in the specification on page 7, lines 1-3.

The subject invention is directed to silane-containing polyvinyl alcohols which have surprising storage stability. Conventional polyvinyl alcohols have no storage stability problems. The viscosity of aqueous solutions prepared from these polyvinyl alcohols is essentially constant over time. However, silane-containing polyvinyl alcohols are known to have significant storage problems, as discussed in the specification and illustrated by the Examples and Comparative Examples.

The claims have been rejected over Schilling et al. U.S. 4,879,336 ("*Schilling*") in view of Maruyama U.S. 4,617,239 ("*Maruyama*"). Applicants respectfully traverse this rejection.

Schilling is directed to polyvinyl alcohols containing 5-50% of 1-alkylvinyl alcohol units. The problem addressed by *Schilling* is mitigation of "pigment shock" in coating slips. Pigment shock is a phenomenon wherein the viscosity of the slip rapidly increases immediately after a polyvinyl alcohol binder is added to the pigment slurry of the coating slip. This sharp increase in viscosity then disappears on further agitation, but over a considerable time, leading to long "batch" times which increase production costs. For example in *Schilling*'s examples, a "straight" polyvinyl alcohol-containing slip showed an increase in power consumption of the stirrer (which is dependent on viscosity) of 31 mW which rose to 90 mW, a factor of 3 increase, 2 seconds after addition of the polyvinyl alcohol, which decreased back to the original slurry viscosity, 31 mW of stirrer power, after 10 seconds (these are laboratory examples - a real industrial example would take much longer). By substituting 10 mol %

2-methylvinyl alcohol units for the vinyl alcohol units of the homopolymer, the increase in viscosity after addition of the modified polyvinyl alcohol was only from 31 mW to 35 mW.

However, *Schilling* does not address the problem of storage stability, nor would he be motivated to do so, since his 1-alkylvinyl alcohol containing polymers have no storage stability problem: their viscosities are stable in aqueous solution. The same is true of polyvinyl alcohol homopolymers. Such polymers exhibit stable viscosities.

Maruyama was published in 1983, same 3 years prior to the German priority date of *Schilling*, and is directed to polyvinyl alcohols modified by silanes. Example 1 is typical, where the polyvinyl alcohol is prepared by polymerizing vinyl acetate and vinyltrimethoxysilane, followed by hydrolyzing the vinyl acetate moieties to vinyl alcohol moieties. The silane content was 0.5 mol %. This is substantially the same as the assignee Kuraray's commercial product POVAL® R-1130, in which the measured silane content is about 0.55 weight percent. While these products are known to have stability problems such as viscosity increase and even gelling, they are not known to exhibit pigment shock, which is not surprising, as the silane modification introduces hydrophobic, crosslinkable groups which render the silane-modified polyvinyl alcohols very different from other, non-silane-containing polyvinyl alcohols.

The Office position is that since *Schilling* suggests using 0-5 weight % of "other" copolymerizable comonomers, it would be obvious to incorporate the silane comonomers of *Maruyama* into the isopropenyl alcohol polyvinylalcohol copolymers of *Schilling*. Applicants respectfully submit that this is not correct, and that there is no motivation to do so.

Schilling desires to reduce pigment shock, yet the copolymers of *Maruyama* are not described as having this effect. Isopropenyl acetate is a much more expensive monomer than vinyl acetate, and one would only use isopropenyl acetate to produce a polyvinylacetate copolymer (hydrolyzable to polyvinyl alcohol) if it is necessary to solve some problem associated with the polyvinyl alcohol not containing isopropenyl alcohol moieties. Thus, if *Schilling* wished to incorporate silane comonomers, he at the same time would eliminate the use of isopropenyl

acetate as a comonomer, since the silane-containing polyvinyl alcohols (*Maruyama*) are not known to have any problem solved by the use of isopropenyl alcohol units, and therefore to include them would only increase the cost of the polymer.

It is particularly noteworthy that even though *Maruyama* was published some three years prior to the filing date of *Schilling*, *Schilling* failed to mention or suggest use of silane-functional comonomers. At column 3, line 45, to column 4, line 2, *Schilling* discusses other potential comonomers. These include polyunsaturated compounds such as divinyl adipate, vinyl fatty esters, and ethylene. None of these are remotely similar to the unsaturated alkoxy silane monomers of *Maruyama*, and would not direct the skilled artisan to their use.

By the same token, *Maruyama* would not motivate one skilled in the art to include isopropenyl acetate in the polymerization, since *Schilling* teaches that polyvinyl alcohols prepared from vinyl acetate and isopropenyl acetate have reduced pigment shock, which is not a problem with which *Maruyama* is concerned. The use of isopropenyl acetate would only increase the cost of his silane-containing polyvinyl alcohols with no known benefit.

Applicants were aware of the storage problems associated with *Maruyama*'s polymers, which contain trialkoxy units capable of crosslinking by condensation. These polymers even gel upon removal of a portion of water when applied to paper, as indicated by *Maruyama* himself throughout the specification. However, neither *Schilling* nor *Maruyama* teach or suggest how these stability problems could be solved. Simply put, no one skilled in the art would be motivated to use isopropenyl acetate to stabilize a *Maruyama* polymer against viscosity increase or gelling. No one skilled in the art would modify *Schilling* to contain silane monomers without also removing the isopropenyl monomers, since there would be no reason for their presence. The claims are non-obvious over the combination of *Schilling* and *Maruyama*.

Moreover, decreasing the propensity of the *Maruyama* polymers towards gelling is directly against the teachings of *Maruyama*. *Maruyama* desires his polymer to gel upon coating of the substrate. See *Maruyama* at column 2, lines 8-13, where the rapid gelling prevents further

absorption of the polymer coating composition into the substrate. The addition of 1-alkylvinyl alcohol moieties into the polymer surprisingly decreases the rate of chain-extension and crosslinking of the Si-bound alkoxy groups, which is responsible for the low storage viscosity stability. However, a high reactivity of these groups is necessary to achieve gellation on the substrate surface by reaction with cellulose fibers of the substrate, as explained at column 9, lines 8-26. Any modification which would decrease the reactivity of the Si-bound alkoxy groups would thwart Maruyama's purpose of rapid gellation of the coating to prevent its penetration into the substrate. Therefore, one skilled in the art would not be motivated to modify a Maruyama polymer to increase its stability, based on the teachings of Maruyama. Applicants, however, have proceeded contrary to Maruyama's teachings. It is certainly not obvious to do so.

Importantly, Applicants have shown surprising and unexpected results. The Office has criticized Applicants' comparative showing as not persuasive for several reasons.

First, the Office states that the inventive example contains isopropenyl acetate rather than 1-methyl vinyl acetate. These are synonyms. The Examiner may wish to refer to the Aldrich catalog or Chemical Abstracts. In Aldrich, for example, 1-methylvinyl acetate CAS:108-22-5 is listed under isopropenyl acetate, its common name (p. 1516, 2007-08 catalog; see also sigma-aldrich.com).

Second, the inventive example is criticized for only containing vinyltriethoxysilane monomers. However, there is no reason why one skilled in the art would believe that other silane monomers would react differently, and the Office has provided no such reasoning. In the accompanying declaration of Dr. Bacher, a new Example 2, with a different silane, vinylmethyldiethoxysilane shows the same stability.

Third, the relative amounts of silane monomers is also criticized. The claims have been narrowed to include up to only 1 weight percent of silane. Applicants believe that the narrowed claims make the Examples and Comparative Examples commensurate in scope.

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Fourth, the Example and Comparative Example are criticized as not being side-by-side comparisons without a Rule 132 declaration describing the POVAL® polymer. This polymer is produced from polyvinyl acetate and 0.55 weight percent vinyltrimethoxysilane - very similar to Example 1 of the Kuraray patent, and having a silane content directly in the middle of Applicants' claimed range of 0.01 to 1 weight percent, as attested to in the Bacher Declaration.

Fifth, the Office states that the data is only for a coating slip and not the polymer alone. This is incorrect. Tables 1 and 2 are directed to the coating slips. It can be seen that the subject invention polymers are comparable to the Kuraray polymers in brightness (2 methods), but considerably better in abrasion resistance, which is unexpected. Moreover, since the only difference between the coating slips is the type of polyvinyl alcohol employed, the increase in abrasion resistance must be due to the polymer, not the coating slip *per se*. It is well established in the chemical arts to show unexpected and surprising differences which are due to a particular compound (here, a polymer) by its use in compositions, or in the pharmaceutical fields, by *in vitro* or *in vivo* studies.

However, Table 3 is not directed to coating slips, but to aqueous solutions of the polymers themselves. The *Maruyama* polymer exhibited a 3-1/2 fold increase in viscosity over only two weeks, at a steadily increasing rate. The subject invention polymer showed a virtually constant viscosity over the same period. In the Bacher declaration, the same viscosity stability is demonstrated by a new Example 2.

Applicants submit, therefore, that unexpected and surprising results have been verified, commensurate with the scope of the claims, and that the subject matter of the narrowed claims are patentable over the combination of *Schilling* and *Maruyama*.

Applicants submit that the claims are now in condition for Allowance, and respectfully request a Notice to that effect. If the Examiner believes that further discussion will advance the prosecution of the Application, she is highly encouraged to telephone Applicants' attorney at the number given below.

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Respectfully submitted,

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